A61N 5/10 B

PATENT SPECIFICATION

(11) 1 558 127

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(21) Application No. 35079/77 (22) Filed 22 Aug. 1977

(44) Complete Specification Published 19 Dec. 1979

(51) INT. CL.² A61N 5/10

(52) Index at Acceptance
H5R 1B

(19)

≈ NL 76 06 676
≈ CH 617 095
≈ DE 27 36 318
≈ FR 2 401 670

(54) IMPROVEMENTS IN OR RELATING TO APPARATUSES FOR INTERNAL IRRADIATION

(71) I, ERIC VAN'T HOOFT, of Dekkersbos 7, Leersum, the Netherlands, a Dutch citizen, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:-

The invention relates to apparatuses for internal irradiation.

In an apparatus of this kind, the applicator tube may form part of a Fletcher applicator comprising three divergent tubes arranged to be introduced into a body cavity and each arranged to receive a radio-active material.

In order that the radiation may be exactly applied to the required locations, the radio-active material is introduced in the form of a row of balls consisting of contiguous radio-active and neutral balls. Thus, irradiation occurs at the locations of the radio-active balls, and there is no radiation at the locations of the neutral balls. The row of balls is composed beforehand, and is pneumatically transferred to the desired applicator tube. Usually, each row of balls contains a fixed number of balls, for instance 48 balls.

The pneumatic pressure moves the row of balls so far into the applicator tube that the foremost ball abuts against the end of the tube. After termination of the irradiation, the row of balls is removed from the applicator tube by pneumatic pressure in the opposite direction. For this purpose, the applicator tube may be double-walled, so that it consists of an internal channel receiving the row of balls, and a jacket surrounding the same. The air for removing the row of balls from the applicator tube is supplied to the jacket, which communicates with the internal channel through an opening at the end of the applicator tube. In order that the radiation be applied to the correct locations, it is, of course, necessary that the balls stay in place during the irradiation. For this purpose, it is usual to maintain the pneumatic pressure used for introducing the balls during the irradiation, so that the row of balls is pressed against the end of the applicator tube.

It has been found, however, that the balls do not always stay in place in practice, since the air exerting the pneumatic pressure may leak past the balls of the row of balls, in particular due to the presence of an opening at the end of the internal channel. This leakage also leads to an excessive air consumption, which may involve a deposition of dirt on the tube walls. In this connection, it is pointed out that the total duration of the irradiation may amount, for certain patients, to more than 40 hours.

According to the invention there is provided an apparatus for internal irradiation, comprising a distributor for composing a row of balls from radio-active and neutral balls, at least one applicator tube arranged to be introduced into a body cavity to be irradiated, and a pneumatic transport system for connecting the distributor to the or each applicator tube and arranged to insert a row of balls in the or each applicator tube and to remove the row of balls therefrom, the or each applicator tube having an end portion of reduced diameter connected by a shoulder to a wider portion, the end portion having a length corresponding to a desired length of the row of balls less a final ball, so that the final ball of each row of balls introduced into the or each applicator tube has a larger diameter than the other balls and is not admitted to the end portion of the or each applicator tube, but is arrested by the shoulder, whereby the other balls are kept in place in the end portion.

In a preferred apparatus, the balls stay in place during irradiation and air consumption is moderate.

The apparatus may comprise a first storage container for the neutral balls, and a second storage container for the radio-active balls.

These containers may be connected through associated valves to the distributor used for composing the row of balls. The distributor may comprise a series of balls directing members, by means of which the valves may be connected to a desired applicator tube. After termination of the irradiation, the balls of the returned row may be supplied to a sorting device directing each ball to the appropriate storage container. If the neutral balls are made of a magnetic material, such as stainless steel, and the radio-active balls are non-magnetic, a magnetic sorting device may be used, wherein the balls are led past a permanent magnet arranged above an opening connected to the second storage container, so that the radio-active balls fall into the opening and are transferred to the second storage container, while the neutral balls do not fall into the opening and are passed on to the first storage container.

Each applicator tube may be associated with an intermediate container of the distributor, in which the row of balls is composed and to which it is returned after use, and the or each intermediate container may be connected to the sorting device through a channel the diameter of which is sufficiently small to prevent the admittance of the final ball, so that each final ball stays in the respective intermediate container. Thus, in the interval between two irradiations, the intermediate container always holds a final ball, which may be added to a row of balls composed in the container.

In order to maintain the correct positions of the balls, it is, of course, necessary that the final ball be firmly kept against the shoulder. In order to check this condition, the wider portion of the or each applicator tube may be connected to an adjustable pressure switch for establishing whether the pneumatic pressure is sufficient to hold the final ball pressed against the shoulder.

A resilient washer may be provided against the shoulder, which provides for a sealing contact with the final ball.

The invention will be further described, by way of example with reference to the accompanying drawings, in which:-

Figure 1 shows schematically means for composing rows of balls and for returning the same after the termination of irradiation; and

Figure 2 shows a longitudinal section of an applicator tube, with an inset of a portion thereof shown at a larger scale.

The apparatus shown in Figure 1 comprises a first storage container M1 for neutral balls, and a second storage container M2 for radio-active balls. Each of these containers is connected through an associated valve A1 or A2 with a distributor consisting of a plurality of series-connected switching members W1-W6. Output conduits of the distributor may be connected, each through an associated switching member HW, with an associated intermediate container TM. The intermediate containers TM are each associated with an applicator tube. Six intermediate containers are shown in the drawing, so that the apparatus as shown may be used to load two Fletcher applicators.

The row of balls is composed, for each applicator tube, in the associated intermediate container. For this purpose, the switching members W1-W6 are adjusted in such a manner that the valves A1 and A2 are connected with the intermediate container in question. After that, the valves A1 and A2 are alternately opened according to a predetermined program, whereby radio-active and neutral balls are supplied to the intermediate container. The row of balls composed in this manner may, for instance, contain 48 balls each having a diameter of 2.5 mm.

Each intermediate container initially contains a final ball, which is added to the composed row of balls. This final ball is a neutral ball, having a diameter, for instance, of 3.0 mm.

As soon as the row of balls has been completed, the switching member HW is changed over, so that the intermediate container TM is connected with a conduit L leading to the associated applicator tube. After that, air is supplied to the bottom of the intermediate container by means of a valve V, whereby the row of balls is moved to the applicator tube.

After termination of the irradiation, the row of balls is pneumatically returned to the associated intermediate container, after which the switching members W1-W6 and HW are adjusted in such a manner that the intermediate container is connected with a sorting device S. The diameter of the conduits forming this connection is so small that they only admit the normal balls (having a diameter of 2.5 mm), and do not admit the final ball. When air is again supplied to the bottom of the intermediate container, the normal balls move to the sorting device S, whereby they are correctly divided between the storage containers, but the final ball is retained in the intermediate container.

Figure 2 shows an applicator tube having a double-walled construction comprising an internal channel 1 and a jacket 2. The row of balls is introduced into the internal channel 1, in such a manner that the foremost ball abuts against the end of the internal channel.

The internal channel 1 has a final portion 4 with a reduced diameter, of which the length corresponds to that of a row of balls, for instance of 48 balls. The final portion is connected through a shoulder 5 to the remaining wider portion of the internal channel. A resilient washer 6 may be placed against the shoulder 5. Upon introduction of a row of

balls, the final ball 7 is arrested by the washer 6, since the diameter is so large that it cannot enter the final portion 4 of the applicator tube. Thus, the final portion 4 containing the balls with a smaller diameter is closed by the final ball, whereby they are kept in the correct place.

After termination of the irradiation, air is supplied to the jacket 2 and introduced into the internal channel 1 through an opening 8 at the end of the applicator tube, whereby the entire row of balls is returned to the intermediate container TM.

In order to provide a possibility of checking whether the balls stay at the right place, the wider portion of the internal channel 1 is connected with an adjustable pressure switch 9, serving to establish whether the pneumatic pressure is sufficient to keep the final ball pressed against the shoulder 5. If the pneumatic pressure disappears, the switch 9 may provide an alarm.

WHAT I CLAIM IS:

1. An apparatus for internal irradiation, comprising a distributor for composing a row of balls from radio-active and neutral balls, at least one applicator tube arranged to be introduced into a body cavity to be irradiated, and a pneumatic transport system for connecting the distributor to the or each applicator tube and arranged to insert a row of balls in the or each applicator tube and to remove the row of balls therefrom, the or each applicator tube having an end portion of reduced diameter connected by a shoulder to a wider portion, the end portion having a length corresponding to a desired length of the row of balls less a final ball, so that the final ball of each row of balls introduced into the or each applicator tube has a larger diameter than the other balls and is not admitted to the end portion of the or each applicator tube, but is arrested by the shoulder, whereby the other balls are kept in place in the end portion.

2. An apparatus as claimed in claim 1, comprising a first storage container for the neutral balls and a second storage container for the radio-active balls, the first and second storage containers being connected to the distributor through associated valves, and a sorting device arranged to direct each ball of a row of balls removed from the or each applicator tube to the appropriate storage container, each applicator tube being associated with respective intermediate container of the distributor in which the row of balls is composed and to which it is returned after use, and the or each intermediate container being connected to the sorting device through a channel the diameter of which is sufficiently small to prevent admittance of the final ball, so that each final ball stays in the respective intermediate container.

3. An apparatus as claimed in claim 1 or 2, in which the wider portion of the or each applicator tube is connected to an adjustable pressure switch arranged to check whether the pneumatic pressure is sufficient to keep the final ball pressed against the shoulder.

4. An apparatus as claimed in claim 1, 2 or 3, in which a resilient washer is provided against the shoulder.

5. An apparatus for internal irradiation, substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

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Printed for Her Majesty's Stationery Office,
by Croydon Printing Company Limited, Croydon, Surrey, 1980.
Published by The Patent Office, 25 Southampton Buildings,
London, WC2A 1AY, from which copies may be obtained.

1558127 COMPLETE SPECIFICATION
1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

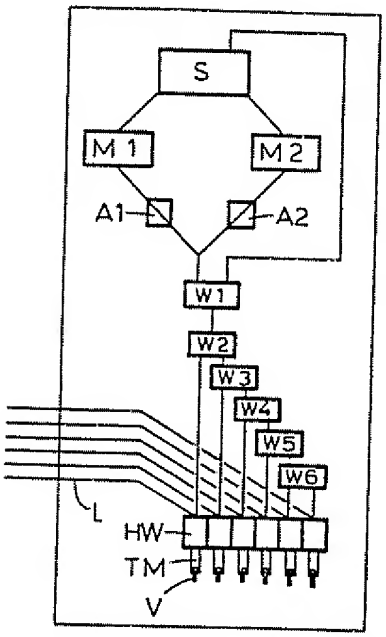

fig.1

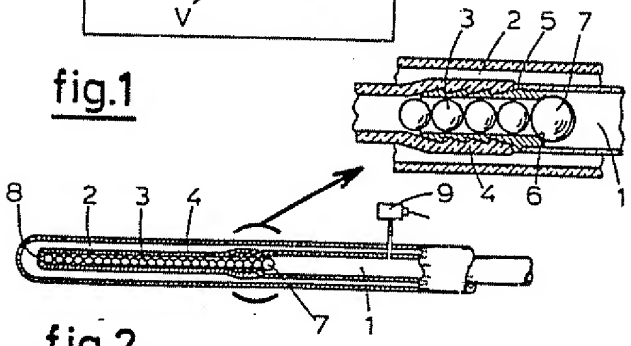

fig.2